

*Crypt. Tracts
(Fungi)*

H. Kuehle with kind regards from

15 DEC. 1909

H. T. Güssow

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

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A SERIOUS POTATO DISEASE OCCURRING IN NEWFOUNDLAND

BY

H. T. GÜSSOW

*Botanist to the Dominion Experimental Farms,
Ottawa, Ont.*



BULLETIN No. 63

OCTOBER, 1909

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To the Honourable
The Minister of Agriculture.

SIR,—I beg to submit for your approval Bulletin No. 63, entitled: 'A Serious Potato Disease occurring in Newfoundland' which has been prepared by Mr. H. T. Güssow, Botanist to the Dominion Experimental Farms. In this bulletin reference is made to the existence and progress of the disease referred to, in Great Britain and in Europe for some years past, where it is known as the Potato Canker. From the facts brought together in this Bulletin, relating to the life history of this disease in Europe, and its discovery by Mr. Güssow in potatoes sent from Newfoundland, it is evident that its occurrence in America is a very serious matter and every effort possible should be made to limit the spread of this disease, and to destroy the diseased tubers whenever they are found.

All the illustrations used in this Bulletin are original and have been prepared by Mr. Güssow, who has studied this disease in Europe, and hence has been able to give full details of its life history.

This descriptive matter with the illustrations will, it is hoped, enable any one to recognize Potato Canker wherever it may occur.

I have the honour to be,
Your obedient servant,

OTTAWA, October 27, 1909.

WM. SAUNDERS,
Director of Experimental Farms.

15 DEC. 1909

OUTBREAK OF A SERIOUS POTATO DISEASE IN NEWFOUNDLAND

POTATO CANKER (*Chrysophlyctis endobiotica*, Schilb.)

BY

H. T. GÜSSOW, F.R.M.S.

Botanist to the Dominion Experimental Farms, Ottawa

INTRODUCTION.

During the past 13 years a serious potato malady has been rapidly spreading in European countries. The disease, which has been known in England since 1901, has received in that country the following names: Black Scab, Warty Disease, Cauliflower Disease of Potatoes, but it is more properly designated as Potato Canker. It has hitherto been unknown on the continent of America, but has now made its appearance on this side of the Atlantic, having been recognized by the Botanist of the Experimental Farms, from diseased specimens of potatoes forwarded from a locality in Newfoundland.

While it is not very likely that potatoes will be imported to any extent from Newfoundland into Canada, yet the extraordinary virulence of the disease in Great Britain, and the remarkable rapidity with which it has spread over practically the whole of Europe, make it necessary to issue a warning to all growers of potatoes to be diligently on the lookout for this serious malady. There is hope that the disease may yet be arrested before spreading to other localities, if timely notice be given to the potato growers of the Dominion. The investigation which has been personally conducted into the nature of the disease, by the writer in Great Britain, proves that it is one of the most serious maladies known. Where allowed to establish itself, it renders the cultivation of potatoes extremely difficult. It is not desired to unnecessarily alarm the growers of potatoes, but it must be borne in mind, that if this disease is through indifference or negligence allowed to establish itself in Canada, there is no hope of being able to save a crop that is once attacked; moreover, the ground on which a diseased crop may have been raised, will be unfit for the cultivation of this important crop again for a period of six years. In this connection, practice and science must, as always, go hand in hand, and if our object in keeping the disease out of the Dominion, be attained, everybody who thus renders assistance, will deserve credit for saving the potato growers of Canada from disastrous losses.

History of the Disease.

The first existing record of the disease is attributed to Prof. Schilberszky, who discovered the disease in Hungary, in 1896. (1) In December, 1902, the Journal of the English Board of Agriculture published an account of this disease by Prof. M. C. Potter who referred its cause to the same fungus as that described by Schilberszky, viz. *Chrysophlyctis endobiotica*. Curiously enough, in the same number this identical

¹ Ein neuer Schorfparasit der Kartoffelknollen, Berichte der Deutschen Bot. Gesellschaft XIV, 1896, p. 36, (cit. Sorauer, Handbuch der Pflanzenkrankheiten, 1908, Vol. 2, p. 116.)

disease was described by Mr. George Massee of Kew, who, however, referred it to the genus *Oedomyces* (*sp. leproides*, Trabut), a disease which was recorded as occurring on beet-root in Algeria, but which according to information received by the writer from Prof. Trabut, is due to a totally different organism than that on the potato. The leaflet of the Board of Agriculture and Fisheries No. 105, published subsequently, repeats the error in identification of the disease as one that is caused by *Oedomyces leproides*, treating it as synonymous with *Chrysophlyctis endobiotica*.

Although the seriousness of the disease was recognized, no systematic steps were taken to stop it from spreading, until it was scheduled as a notifiable disease by the 'Destructive Insect and Pests Order of 1908' (issued under the Destructive Insect and Pests Acts, 1877 to 1907) which renders persons concealing this disease liable to prosecution and a heavy penalty. During the years that have elapsed since the disease made its first appearance in England in 1901, it has slowly but surely spread from county to county and during the year 1908, 244 cases were reported to the authorities under the new Act. The disease now prevails in Ireland and Scotland and was recently recorded as appearing in Scandinavia, Germany, France and Italy.

It is now prevalent over the greater part of Europe. From what has been stated, it will be evident that a most serious pest has to be combated. In order that it may be possible to recognize the disease in all its stages it is desirable to describe carefully its

Appearance in the Field.

The disease is unfortunately not noticeable, until the potato crop is being harvested, thus the disease is liable to contaminate the ground, without being observed, as is not the case with diseases affecting plants above ground, such as 'Late blight,' *Phytophthora infestans*, (Mont.) de Bary.

Where the disease is prevalent, practically no healthy tubers will develop. The tubers when lifted, show signs of various degrees of injury. Some appear on casual examination to be sound. But the 'eyes' of the tubers should be carefully examined, those are the places where the disease is first noticeable. The eyes of affected tubers show an abnormal development of the dormant shoot. A careful untrained observer can easily recognize the presence of the disease in this stage. At the same time it is in this condition that the disease is most likely to escape detection and to be spread by means of infected tubers used for seed. In the earlier stages of the disease, the eyes will be found to be slightly protruding in the form of a single or compound group of small nodules varying from the size of a pin's head to that of a pea. Figure 1 'A' shows a section through a tuber slightly affected, the nodules being plainly visible at four points where in healthy tubers eyes would have been situated.

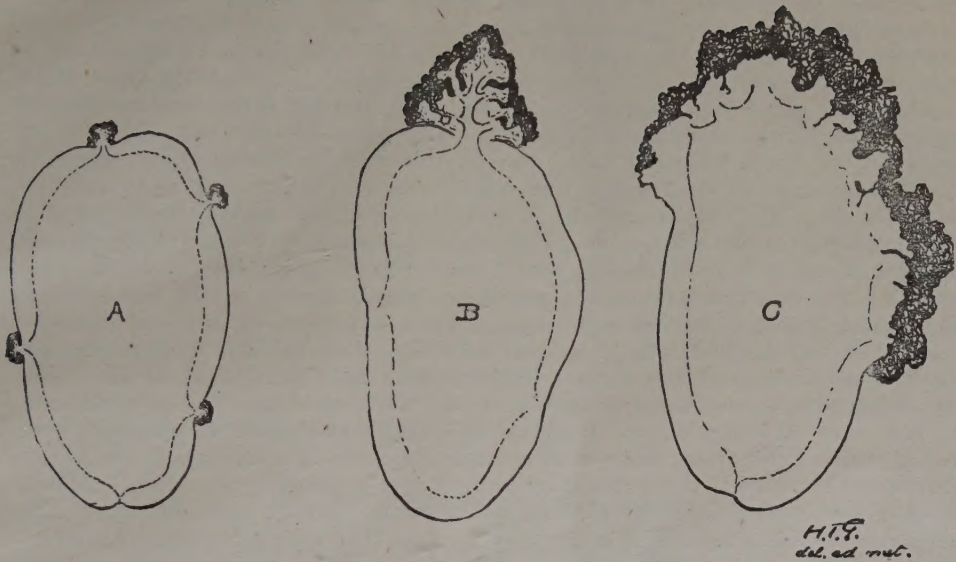


FIG. 1.—POTATOES SHOWING DISEASE OF POTATO CANKER CUT IN HALVES

- A.—A tuber showing four eyes attacked by the fungus *Chrysophlyctis endobiotica*, Schilb.
 B.—A tuber showing upper eye only attacked.
 C.—A tuber half covered by the excrescences caused by the fungus.

When an infected potato is washed in water, this small nodule is easily distinguishable from a sound eye by its colour. The colour of a sound eye may be white, rose or purplish, while the diseased nodule is of a rusty brown colour showing no resemblance to an eye of the potato, with which every grower is doubtless familiar.

There can be no doubt that the disease was introduced into Newfoundland by means of diseased seed tubers, imported from infected areas, and it must be strictly emphasized that the examination of every tuber that is planted is one of the surest ways of keeping the disease out. No suspected tubers should be planted; they should be kept separate and samples be sent to the Botanist, Central Experimental Farm, Ottawa, who will gladly examine such samples and report whether the suspected tubers are diseased or not. Considerable losses may be averted by such precautions and the care taken when planting sound potatoes will be amply repaid at harvest time. If diseased tubers be planted, the crop may be doomed, the land will be infected, the disease will have gained a foothold and the future cultivation of potatoes throughout the country may be seriously influenced. Great care should be taken, when planting potatoes, especially when imported from any part of Europe, to ascertain whether the seed tubers come from infected areas. While, as already stated, there may be but slight danger of importing seed tubers from Newfoundland, yet, that the disease may be introduced in this way, is not impossible, especially as the extent of the distribution of the disease cannot be accurately ascertained at the time of writing.

Further stages of the disease are as follows: Some tubers will be found, when the crop is harvested, with more or less than one-half of them covered by these nodular excrescences which may be larger, than the original tuber itself. Figure 1 'B' and 'C' plainly show the features of this stage when the diseased tubers are cut in halves. The growth consists here of a mass of coral like, or more or less scaly excrescences or nodules similar in appearance to the well known crown or root gall of apples. The adherent earth can be easily washed off when the character of the growth becomes more apparent. It is not spongy and not detachable from the tuber. It is of a somewhat lighter colour at the base and dotted with minute rusty brown spots over the surface. In an advanced stage the tubers are wholly covered by this growth, having lost every

resemblance to potatoes. They are lumps as will be seen in figure 2, 'A' and 'B' of irregular outline, never spherical or oblong, but simply a mass of ragged and edged excrescences. Figure 2, 'A' represents a whole plant as dug from a diseased field of potatoes. It clearly shows the extraordinary change which the tubers undergo. Right in the centre of 'A' a tuber will be noticed, comparatively little attacked, showing however, plainly the excrescences by which it is covered. The two dark masses represented in 'B,' fig. 2, are potato tubers totally covered by the disease as just described. A still more advanced stage occurs, when the fungus has utilized every particle of food stored in the tuber and has reduced it to a brownish black soft mass, giving off a very unpleasant putrefactive odour. This is the most dangerous stage of the disease; and tubers which have reached it cannot be harvested whole, they break in pieces and thus the brownish pulpy mass, consisting almost entirely of the spores of the fungus and remains of the cell walls of the potato is broken up, the spores are liberated in millions, and the land is badly infected for years. Infected soil will for years produce unsound crops and here we have another risk in the dissemination of the disease, by the carrying to uninfected areas infected soil adhering to the boots of workmen or to farm carts and implements. It should be stated that though the disease is most conspicuous in the tubers, cases have come to the author's notice where the haulms and lateral branches of the plants above ground were attacked by the fungus, showing more or less large clusters of excrescences, exhibiting, through the influence of light acting on the colouring matter in the plants, a somewhat leafy greenish appearance.

Damage Caused by the Disease.

It has been stated that no sound tuber is saved from a crop that is attacked. While the virulence of diseases like 'Late blight' or 'Early blight' (*Alternaria solani*, Sor.) are more or less dependent upon climatic conditions, this disease is not influenced in any known degree by physical or mechanical conditions. It may, therefore, be considered as the most serious pest attacking potatoes. Fields, at harvest time in affected areas, present the most hopeless appearance; the disease has caused the greatest havoc in all localities where it has appeared.

Pathology of the Disease.

The fungus *Chrysophlyctis endobiotica*, Schilb. belongs to the order of *Chytridinea*, the genera of which produce no mycelium like the main groups of fungi. It reproduces itself by resting sporangia in which numerous swarm spores are formed. When examining a diseased tuber, cutting right through a portion of the abnormal growth it will appear as represented by the illustration, fig. 1 'A,' 'B,' 'C.' Cutting a fine section of one of the nodules and examining it under the microscope one can easily detect the parasitic organism lying closely under the surface and masses of which cause externally the rusty-brown dots already mentioned. Figure 3 'A' represents a micro-photograph reproduced from such a section, showing plainly the diseased organism in the form of black dots living in the external cells of a diseased nodule. The diseased tissue is not covered by a protective epidermis. The cells immediately on the surface show under the microscope more or less sharply defined round or oval colourless bodies which represent earlier stages in the life-history of the fungus. The irritation caused by these organisms in the potato produces a prolific outgrowth of enlarged (hypertrophied) cells, which are attacked from the outside by means of minute swarm spores of the fungus. These renewed attacks, give rise to a continuous production of cells and the large excrescences result as shown in the figures. Lying closely underneath the colourless bodies, will be found the resting sporangia of the fungus. They are from 50 to 70 micromillimeters in size and are gobular to oval, dark-brown, transparent bodies with no lateral depressions, and the surface of which is covered by slightly darker brown ridges composed of the membranes of the cell walls which protect the contents. Figure 3 'B' is reproduced from a highly enlarged micro-photograph and gives an idea of the size, shape and number of these resting sporangia. The original object from

which this photograph was taken was less in size than a pin's head; the number of these organisms may be easily estimated from so small an object. For the information of pathologists it may be mentioned that the resting spores appear almost like those of the *Peronosporæ*. The contents of these spores appear as a granulated mass under the microscope. The artificial germination of the resting spores has proved of extraordinary difficulty. For many years all experiments to germinate the spores resulted in failures, and the life-history of this obscure fungus remained unknown until quite recently, when Prof. T. Johnson, of the Royal College of Science, Dublin, succeeded in discovering the germination of the resting spores. As it was expected, the walls of the sporangia split, allowing the escape of numerous zoospores. A new infection takes place by the penetration of these swarm or zoospores from the soil or by the internal passage of plasmodium from diseased tubers, used as seed, to the new tubers formed on the plant. Potato tubers completely decomposed by this disease have been collected, dried thoroughly and kept in this condition for some years. These were afterwards mixed with soil and, when sound tubers were planted in the soil so inoculated, the disease reappeared vigorously. This illustrates plainly the longevity of the spores of the fungus by which the disease is spread.

Method of dealing with the Disease.

The appearance of a diseased crop has already been indicated; when a grower finds his crop attacked, he may hesitate to destroy potatoes which appear sound or but little affected, although total destruction would be the best means of preventing the spread of the disease, yet those tubers may be collected, boiled and be fed to pigs. Under no circumstances should unboiled or decayed potatoes be given as food. Not only because the feeding value is sure to be reduced, but mainly because the spores are still capable of germinating after passing through the body of an animal. In removing the potatoes from the field, the greatest precaution should be taken to clean thoroughly and disinfect one's boots and the farm carts and implements used. Straw may be used to wipe off the adhering soil and everything to which soil adheres should be washed with a 1 in 800 solution of Bichloride of Mercury or Corrosive Sublimate. The process of disinfecting may be carried out on boards laid on the field, &c., so that no reinfection take place afterwards. The grower should then proceed to dig a hole in the field and collect all refuse from the vines and all diseased tubers. The potato straw should be destroyed by fire; but the tubers, being too wet to burn, may be dealt with as follows:—The hole that has been dug must be big enough to hold all the tubers collected; it should then be covered with a layer, 6 inches deep, of unslaked lime; then a portion of the tubers may be thrown in and covered by another layer of unslaked lime, and so on till the hole is filled. The last layer should be formed, of course, by the lime. In this manner the tubers are put out of harm's way. In some localities unslaked lime is difficult to obtain. For these districts may be recommended a quantity of sawdust thoroughly soaked in a 1 in 500 solution of Bichloride of Mercury. This should be mixed after soaking, with the tubers that are to be destroyed. The tubers may then be buried. These pits should be dug in some portion of the field where they may remain untouched for three years. When the land is thus cleaned, it should be fallowed and treated with unslaked lime at a rate of 4 or 5 tons per acre. Where lime is not obtainable, one must resort to the spraying of the ground with a 1 in 800 solution of Bichloride of Mercury by means of a liquid manure distributor or potato or any other kind of sprayer. In fields worked on a four course rotation, growers should replace the potatoes by some other crop. Any other crop may be grown.

Prevention of the Disease.

Under no circumstances should seed potatoes from a diseased crop be used. If 'seed' is suspected of the disease, the sets should be powdered with sulphur and be stored in boxes until planted. Four or five lbs. of sulphur suffice to treat one ton of

potatoes. Examine carefully every tuber before planting, or submit them to an expert. Inquire carefully, when buying seed potatoes, where they come from, and guard against using any from infested areas.

CONCLUSION.

1. The disease known as 'Potato Canker,' 'Black Scab,' 'Warty Disease' and 'Cauliflower Disease of Potatoes,' due to the fungus *Chrysophlyctis endobiotica*, Schlib., which caused severe losses amongst European potato crops, has for the first time appeared on this side of the Atlantic, being reported from a locality in Newfoundland.

2. *Growers or consumers of potatoes must guard against the introduction of this disease into the Dominion of Canada by selecting sound potatoes for cultivation and by strictly rejecting any that appear diseased.*

3. As yet, no case of the disease has been recorded from any locality within the Dominion. In the event of the disease appearing, samples of tubers should be submitted *without delay* to the Botanist, Central Experimental Farm, Ottawa, for examination and advice.

4. Specimens of this disease preserved in alcohol will be sent to any agricultural institution or college for the purpose of having type specimens for reference, as soon as ready.

5. Copies of this bulletin may be had free of charge on application to the Central Experimental Farm, Ottawa.

6. The present bulletin has been prepared as a warning, in the hope that all potato growers, merchants, gardeners and private individuals will take immediate steps to report promptly any cases of the disease which may come to their knowledge, and so join in preventing the spread of this serious malady which has unfortunately assumed such dangerous dimensions in Europe.

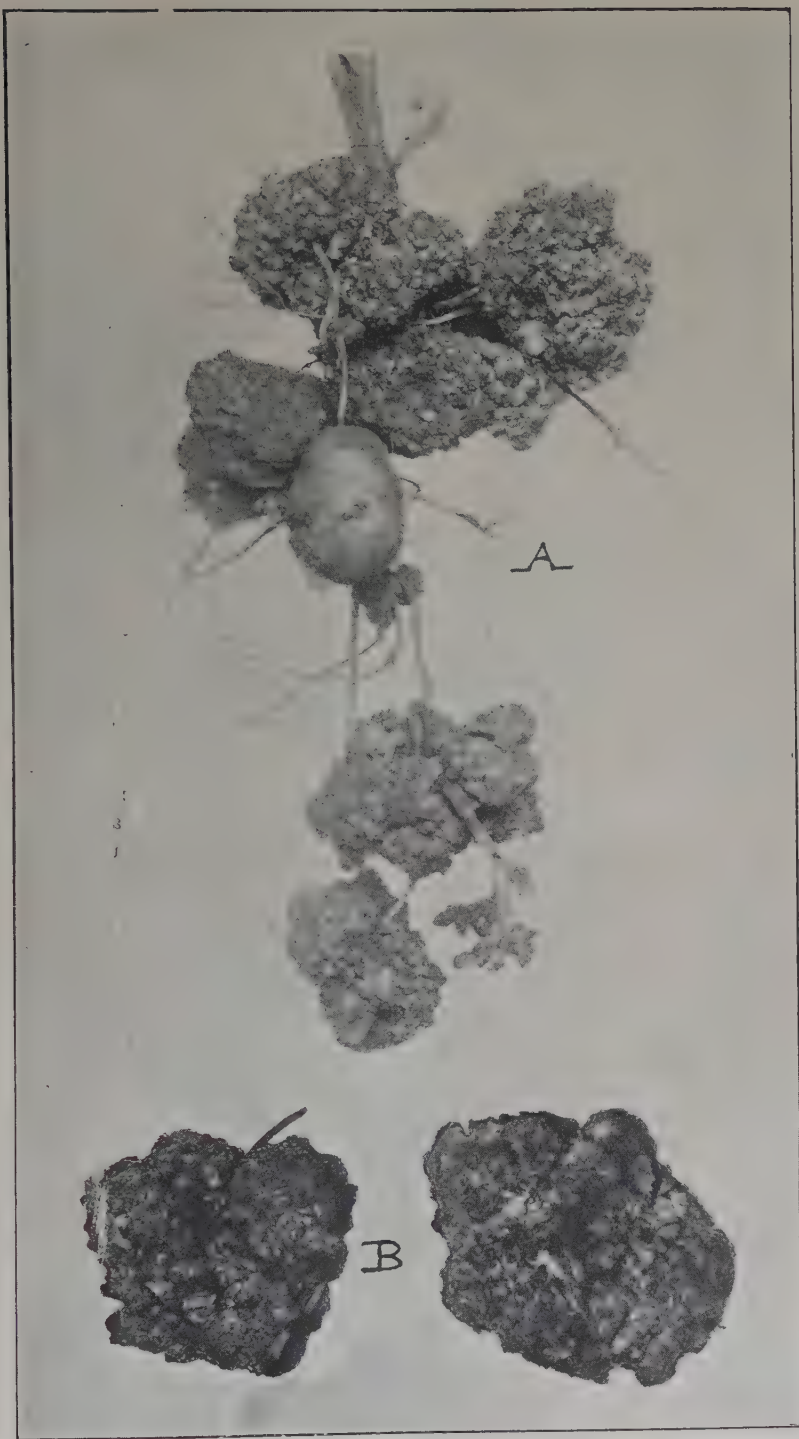
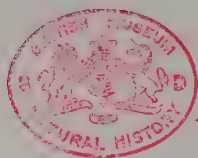


FIG. 2.—POTATO CANKER.

A. A plant of diseased potatoes as it appears when dug; showing in the centre a partially sound tuber covered with excrescences caused by the fungus at the base; also showing six malformed tubers adhering to the plant.

B. Two tubers natural size badly diseased.



A



B

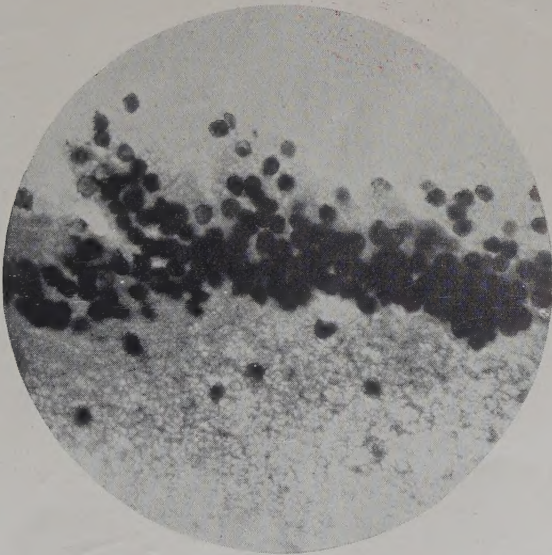


FIG. 3.—SECTIONS OF DISEASED TISSUES OF POTATOES AFFECTED BY POTATO CANKER.

A. Microphotograph of a small diseased nodule showing numerous resting sporangia of the fungus lying closely on the surface.

B. Portion of the same section more highly magnified showing shape of the sporangia.

